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U. S. Bureau of Medicine
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Manual on rat control.

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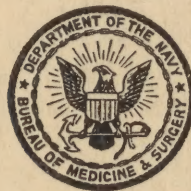


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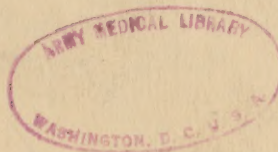
NAV MED 518

Manual on
RAT CONTROL
American Mainland and Pacific Region



u.s.
U.S. Bureau of Medicine and Surgery,
Navy Department

Washington, D. C.
1944



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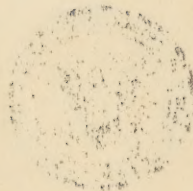
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INTRODUCTION

The common house rats and the semi-wild forms are important reservoirs of diseases that affect man. Damage to all types of materiel is a secondary but important reason for controlling rats in proximity to military bases, camps, and installations and aboard ships. Effective control requires some knowledge of species and habits of the rat population.

DESCRIPTION AND CLASSIFICATION OF IMPORTANT RODENTS

Three species of common house rats occur generally on the American mainland. In addition to these forms, several other species occur in the Pacific area. The semi-wild forms which live in the jungle or forest and waste-land have little contact with man and are relatively unimportant in rodent control; military occupation and operations may change this picture to some extent. The semi-domestic forms which will require consideration and control are briefly described. The KEY is supplied for the purpose of separating and classifying rats on the mainland and those in the Pacific area. The most important rats from the medical and economic viewpoint are:

Rattus norvegicus - Norway (Brown) Rat. - The Norway rat is fairly large, usually russet or grayish-brown on the back and sides, the underparts having a slight gray to yellowish-white color. This rat is present wherever human habitation creates suitable harboring places and an adequate food supply. It is persistent and aggressive and lives in association with other rats. Due to its greater adaptability and on account of its habit of living on and in the ground; it is generally the most noticeable and numerous species. It lives with people and feeds on the products of the field and factory.

Rattus rattus alexandrinus - Alexandria (Egypt) Rat; Gray (Roof) Rat. - This rat is usually a grayish-brown to black on back and sides, the tips of the underfur being white and grading to a slight gray at the base. The contour of the body is rather slim and elongate. It is a good climber and will be found in upper stories of buildings, on the roofs of houses, and in trees. It tends to become widely distributed and is generally regarded as a pest in many out-of-the-way places. Trapping and poisoning methods require some adaptation to fit these specialized habits.

Rattus rattus rattus - Black Rat. - This rat is slaty-black on all parts of the body. It is not commonly encountered in any considerable number, except in special types of environment, and does not usually become a pest on a wide scale.

Rattus rattus frugivorus - White-Bellied Rat. - This rat is slaty-gray to tawny on back and sides with white hairs on belly and is generally referred to as "the white-bellied rat." Its habits are similar to those of the Alexandria Rat which it appears to supplant in some localities. Routine methods of control are generally effective in dealing with this species. It is found mainly in the Pacific area.

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Description and Classification

Rattus exulans subspecies - Polynesian Rat. - On all the oceanic islands of the Pacific there are many forms or species of small, semi-wild rats which can be easily distinguished from any of the larger, semi-domestic forms. They are generally dark brown to light brown in color and range from very small to medium in size. They can be separated as a group, but only a trained mammalogist can hope to place them as to species. Control operations require exposure of baits and traps near natural habitat and cover and on a systematic, extensive scale. (Specialized types of medium-sized and large rats will also be encountered in the Pacific area.)

Mus musculus - House Mouse. - This is a small species, varying in color from dark brownish-gray to light reddish-brown above, underparts gray. The house mouse is important in disease transmission and food contamination. It must be considered in connection with damage to food supplies and food containers. Control measures must contemplate persistence and ingenuity in baiting traps and exposing bait in order to get a high percentage of acceptance and control.

Note on Life History:

Rats and mice start breeding at three to four months of age; gestation period 21 - 25 days. Litters vary in numbers from six to fifteen with an average of eight; from eight to ten litters each year.

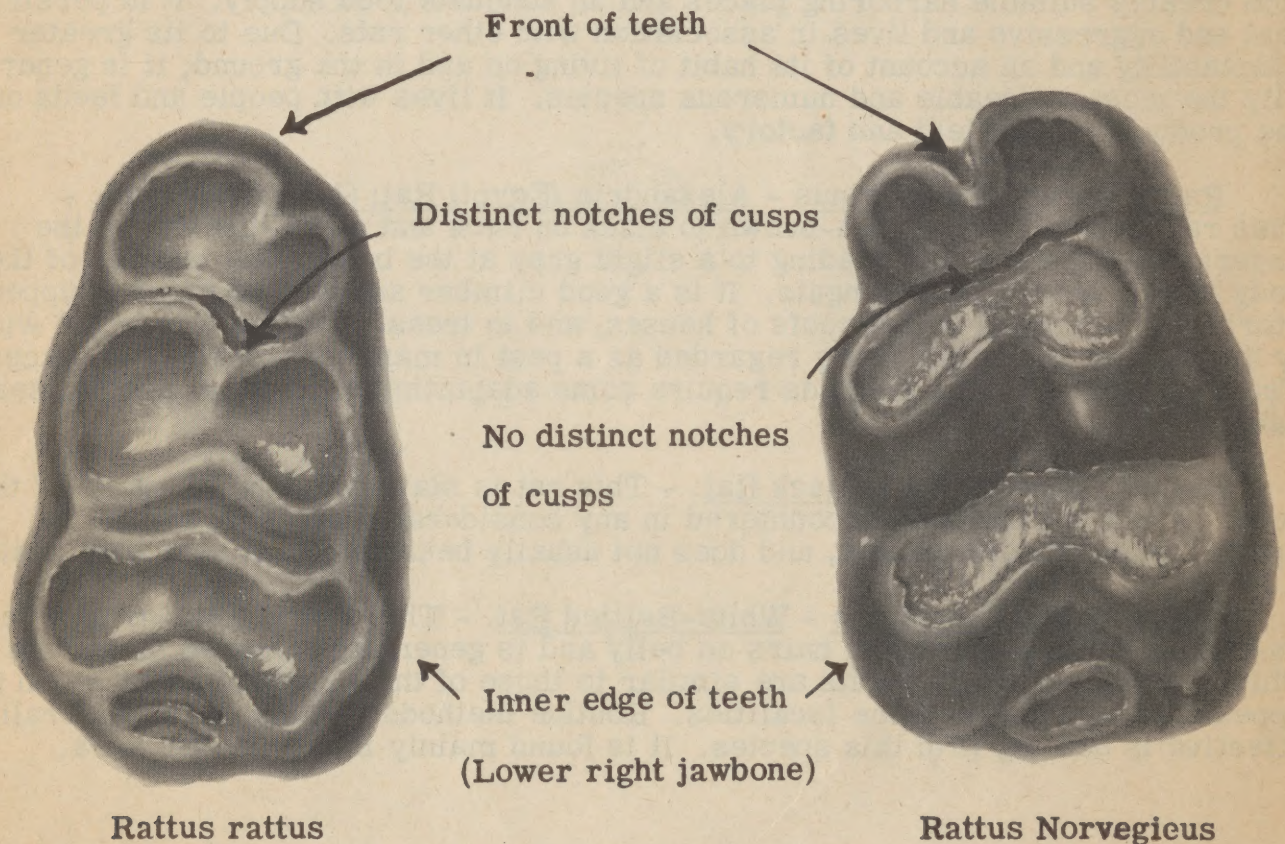


FIG. 1. Dental Characters of First Molar Tooth.

KEY - Semi-Domesticated Rats of
American Mainland and Islands of the Pacific Area

- A. Total length (including tail) less than 300 mm.
- b. Back tawny or brownish; total length, adults, 230 - 290 mm.; length of tail, 120 - 150 mm.; length of hind foot, 23 - 30 mm.; length of ear from notch, 14 - 20 mm. (Small Polynesian Rat) Rattus exulans subsp.
- AA. Total length (including tail) more than 300 mm.
- B. No distinct outer cusp (style) on first row of cusps on first molar (cheek) tooth (See Fig. 1).
- c. Tail more or less bicolored; head and body robust; length of tail usually less than length of head and body; ear short, normally does not extend more than half-way to eye when laid forward. Total length, adults, 325 - 460 mm.; length of tail, 150 - 215 mm.; length of hind foot, 38 - 46 mm.; length of ear from notch, 16 - 20 mm.
(Norway Rat) Rattus norvegicus
- BB. A distinct outer cusp (style) on first row of cusps on first molar (cheek) tooth; tail unicolored; head and body more slender; length of tail usually greater (at least equal to) length of head and body; ear long, reaching half-way to eye when laid forward; hind foot, 36 - 42 mm.
- d. Back slaty or slaty-black; color above and below similar. Total length, adults, 390 - 450 mm.; length of tail, 185 - 250 mm.; length of hind foot, 36 - 40 mm.; length of ear from notch, 24 - 26 mm.
(Black Rat) Rattus rattus rattus
- dd. Back tawny; underparts not slaty or slaty-black (except in worn pelage when tips of hairs are worn off).
- e. Belly never clear white or lemon-colored, and hairs always slaty at base on underparts (except occasionally on throat and chest); belly may appear grayish in worn pelage. Total length, adults, 350 - 450 mm.; length of tail, 190 - 250 mm.; length of hind foot, 34 - 42 mm.; length of ear from notch, 20 - 27 mm.
(Alexandria Rat) Rattus rattus alexandrinus
- ee. Belly white or creamy (lemon) and hairs white to base; ground color of back, tawny; no gray margin at line of demarcation between ground color of back and the whitish belly. Total length, adults, 345 - 455 mm.; length of tail, 190 - 255 mm.; length of hind foot, 34 - 40 mm.; length of ear from notch, 20 - 24 mm. (White-Bellied Rat)
Rattus rattus frugivorus

THE CONTROL PROGRAM

A preliminary survey should be made of any area where a control program is contemplated. The species of rats present and their relative numbers, cover and food conditions, and proximity of native habitations and centers of population are carefully noted. Soil and climatic conditions are studied. Movements and habits of rats in the locality are determined. As a part of this survey, a reasonable number of traps and baits should be exposed over a wide area to give a representative cross-section of the rat population; typical specimens of the region should be prepared from the rats picked up. On the basis of these observations, completed rapidly and thoroughly, the control program is planned.

Area-wide application is the only type of rat control to be considered or attempted. Simultaneous removal of all species is highly desirable to preclude reinfestation by specialized types of rats. A "campaign system" is the surest means of eliminating the major portion of the rat population in a given area. In order to accomplish this, materials must be assembled in sufficient volume to cover the entire area completely and throughly with the initial control effort.

The usual control program begins with starving the rats and building them out. It is imperative that local sources of rat food be eliminated. Both natural and artificial foods, especially garbage, must be made inaccessible. Buildings and storage spaces must be made rat-proof. A specially trained crew is assigned to complete the clean-up and rat-proofing operations simultaneously, to have everything in readiness for exposing baits, setting traps, or other types of control measures that may be employed. If it has been determined that prebaiting is desirable, this is done while eliminating the food sources and rat-proofing.

The weather is considered next, since this is the most important single factor influencing control operations. Available weather charts are carefully studied; poison baits should be put out when it appears that the weather will be clear during that afternoon, night, and the following morning. Weather will make or break any rat control project in which poison bait is used extensively. Rain and wind invariably interfere with the normal nocturnal movements of the rats and destroy the baits. It is always good business to wait for the right break in the weather; then employ all possible bait in the area to be controlled.

On the day following the exposure of poison baits, the control crew patrols the treated area, picking up the dead rats and any tainted or spoiled baits and putting out additional baits where needed. (CAUTION: Do not use bare hands.) This routine is repeated for a second or third time, depending upon the weather and the rat population. Not later than the fourth day, all remaining baits are picked up and destroyed. This completes the initial stage of the program. If it has not been successful, the work must be repeated: more clean-up, more rat-proofing, more experimentation with various types of baits, prebaiting, and poisoning.

The final stage of control becomes what is termed "follow-up" work; an attempt to outsmart the remaining wise rats and keep ahead of the "ever-pregnant" female. Traps, fumigants, and special baits are used as required or available. Try to poison, trap, or gas that last rat, every effort being made to expose or starve him. "Clean-up and Rat-proof" becomes the slogan at all times.

POISONING

The proper use of poisons is the surest and best method of controlling rats. The preparation of the area for receiving baits and the exclusion of rats from natural and artificial food supplies and from cover have been discussed.

PREPARATION AND DISTRIBUTION OF BAIT:

The "body" or consistency of bait materials should be such that the finished product can be cut or pressed into small cubes or balls or wrapped in tissue paper. Wrapping baits in tissue-thin paper gives them a torpedo-like appearance and they are called "bait torpedoes". This method of preparation has the advantage of keeping the bait clean, affords some protection from ants, cockroaches, and flies, and facilitates distribution. Torpedo baits can be made up rapidly and are recommended for general use along with bait prepared in cube form. Some bait may be prepared in loose form to be distributed with a spoon and placed in small piles.

Bait materials should be mixed in clean containers with a spoon, paddle, or shovel. In combining the various bait ingredients, care should be taken to insure thorough and complete mixture of the poison with the base materials. CAUTION: Rubber gloves should be worn in that part of the preparation where it is necessary to touch the materials with the hands to avoid contact poisoning. All utensils used in preparing poisoned baits should be thoroughly washed after use and properly labeled. All poisons should be kept in a safe place.

Baits should always be prepared and distributed on the same day to assure their being fresh when exposed. They should be prepared and distributed in the late afternoon if practicable or possible. Poisoned baits should be placed in groups of two to five or more pieces, using two or three varieties of bait at each bait spot. Poisoning is most effective when plenty of bait is used; it is good economy to use bait liberally. The bait spots should completely blanket the area infested by rats in order that every rat be exposed to one or more baits of each type; use two or three mixtures of bait materials to insure the maximum acceptance. The choice of bait materials will be influenced by the results of prebaiting.

PREBAITING:

This consists of exposing fresh, unpoisoned baits, prepared precisely as the poisoned baits except that the poison is omitted. Prebaiting will increase the chances of success in poisoning and is used to discover what bait the rats take best - where and how much. The most acceptable food items are then used as the base for the poisoned baits. The foods used for prebaiting should be selected from the following classes, trying one of each if available: Cereals - bread, oatmeal, cornmeal, grains. Meats - hamburger, liver, salmon, fresh-ground fish. Fruits and Vegetables - melons, bananas, coconuts, peanut butter.

FEEDER STATIONS:

The use of feeder stations is recommended as an aid to prebaiting and poisoning. These stations protect the bait from domestic and wild animals and also from the weather. In addition, they provide sheltered places where the rats may feed, thus increasing their confidence. Feeder stations should be of a type that are easily cleaned and, for convenience in storing and moving, should be constructed of light material. For rats, they need not be larger than 12 inches long, 12 inches wide, and 6 inches high; larger sizes are as effective if the entrances are made small. Watering stations may also be used to attract and control rats, especially in locations where rain is infrequent and water becomes scarce at certain times of the year.

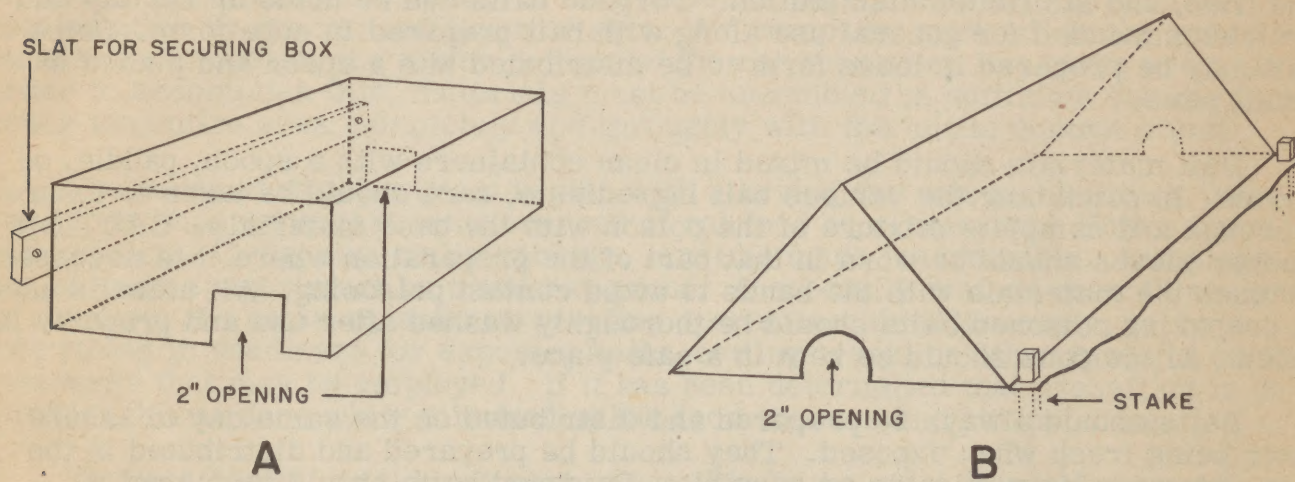


FIG. 2. (A) Feeder Station Made from Wooden Packing Box.
(B) Triangular Feeding Station Made from Five-Gallon Oil Can.

POISON BAIT FORMULAS:

The following computations have been made for the convenience of persons using small lots of bait. Accurate scales should be used to measure both the food and the poison. In emergencies only, when scales are not available, volume estimates (cupful, tablespoonful, teaspoonful) appended to the table may be used. However, it should be clearly understood that this is an emergency procedure and does not conform to recommended practices. A set of plastic spoons and a standard measuring cup should be used for measuring volumes. All cup and spoon measurements should be level. None of the formulas listed show the use of native fruits, nuts, coconut, fish, or other bait material that might be available. These native materials may be substituted in proper proportions for the materials listed.

Thallium, arsenic, and zinc phosphide should be dusted on the bait materials as they are being mixed. In using red squill, water is added to the squill to make a paste which is in turn mixed with the bait materials. Thallium sulphate and zinc phosphide have proved most effective for operations under controlled conditions. Red squill can be used safely where native populations cannot be excluded from the control area.

Poisoning

The following abbreviations are used in the formulas - pound (lb.), ounce (oz.), cupfuls (cup.), teaspoonfuls (tea.), tablespoonfuls (table.). The amounts given will make approximately one and ten pound lots. Only one poison should be used with each formula.

INGREDIENTS	One pound lot	Ten pound lot
1) Ground bread crumbs	1 lb., or 6 cup.	8 lb.
" bacon	2 oz.	1 "
Arsenic trioxide	0.6 oz., or 1 table.	4.4 oz., or 8 table.
Barium carbonate	3.6 " , " 11 "	1 lb., 13 oz.
Red Squill (powder)	2.0 " , " 10 "	1 lb.
Thallium sulfate	0.3 " , " 1/2 tea.	2.2 oz., or 1-1/3 table
Zinc phosphide	0.2 " , " 1 "	1.5 " , " 2-1/3 "
2) Ground bread crumbs	14 oz., or 5-1/2 cup.	7 lb.
Peanut butter	2 oz., or 3-1/2 table.	1 "
Blackstrap molasses	2 " , " 3 "	1 "
Arsenic trioxide	0.6 oz., or 1 table.	4.4 oz., or 8 table.
Barium carbonate	3.6 " , " 11 "	1 lb., 13 oz.
Red Squill (powder)	2.0 " , " 10 "	1 lb.
Thallium sulfate	0.3 " , " 1/2 tea.	2.2 oz., or 1-1/3 table.
Zinc phosphide	0.2 " , " 1 "	1.5 " , " 2-1/3 "
3) Ground bread crumbs	1 lb., or 6 cup.	10 lb.
Peanut butter	1.6 oz., or 3 table.	1 "
Cottonseed oil	0.4 " , " 1 "	4 oz., or 11 table.
Arsenic trioxide	0.6 " , " 1 "	5.6 oz., or 10 table.
Barium carbonate	3.6 " , " 11 "	2 lbs., 4 oz.
Red Squill (powder)	2.0 " , " 10 "	1 " , 4 "
Thallium sulfate	0.3 " , " 1/2 tea.	2.8 oz., or 1-2/3 table.
Zinc phosphide	0.2 " , " 1 "	1.9 " , " 3 "
4) Ground bread crumbs	8 oz., or 3 cup.	5 lb.
" hamburger (fresh)	8 "	5 "
Glycerine	0.5 oz., or 3/4 table.	5 oz.
Arsenic trioxide	0.5 " , " 1 "	5 " , or 9 table.
Barium carbonate	3.3 " , " 10 "	2 lb., 1 oz.
Red Squill (powder)	1.7 " , " 8 "	1 " , 2 "
Thallium sulfate	0.3 " , " 1/2 tea.	2.5 oz., or 1-1/2 table.
Zinc phosphide	0.2 " , " 1 "	1.7 " , " 2-1/2 "
5) Ground bread crumbs	11.6 oz., or 4 cup.	8 lbs.
Cream cheese	3.0 " ,	2 "
Mineral oil	0.2 " , or 1/2 table.	2 oz., or 6 table.
Arsenic trioxide	0.5 " , " 1 "	5 " , " 9 "
Barium carbonate	3.0 " , " 9-1/2 "	2 lbs.
Red Squill (powder)	2.0 " , " 10 "	1 lb., 2 oz.
Thallium sulfate	0.2 " , " 1/3 tea.	2.4 oz., or 1-1/2 table.
Zinc phosphide	0.15 " , " 1 "	1.7 " , " 2-1/2 "

Poisoning

POISON-WATER FORMULAS:

Thallium sulphate can be dissolved in cold water to make a two per cent solution; two pounds of thallium sulphate to 98 pounds of water, or in this proportion makes a good poison-water solution.

Sodium arsenate or sodium arsenite at the rate of 187 grams to 3 quarts of boiling water, adding 170 grams or 16 ounces of heavy corn syrup, is satisfactory.

Add 0.5 gram of green or red vegetable dye to color the solutions. They can be used to good advantage if water is not readily available to rats.

MOUSE POISONING FORMULAS:

Mix one tablespoonful of gloss starch in one-half teacupful of cold water and stir into one pint of boiling water to make a thin, clear paste. Add one ounce of powdered strychnine or one and one-half ounces of zinc phosphide to this paste to make a smooth mixture; add one-half pint of heavy corn syrup and one teaspoonful of glycerine. Apply this poison paste to ten pounds of rolled oats, milo maize, or canary grass seed. Mix thoroughly to coat each kernel and spread on a clean surface or a sheet of paper to dry. Place this bait in containers such as cigar boxes, mailing tubes, pipes, or metal boxes. Locate containers in permanent-type stations, in warehouses and materiel dumps as the supplies are being unloaded and stored.

Fresh fruit, sweet potatoes, or other bait material may be used as bait for mice, using the formulas given for preparing rat bait.

ANTIDOTES:

Thallium sulphate and white arsenic are powerful poisons and should be used with the utmost caution; zinc phosphide, while not so highly toxic, is also dangerous. Red Squill has the distinct advantage of being relatively harmless to domestic animals and humans, mainly because it acts as an emetic when taken in dangerous quantities. In case of accidental ingestion, the following antidotes should be administered at once:

Thallium sulphate. - Wash the stomach with a copious quantity of one per cent sodium or potassium iodide in water. Give cathartics, avoiding sulphates; apply external heat; give stimulants and artificial respiration if necessary.

White arsenic. - Administer four fluid ounces of Magma of Ferric Hydroxide. In case of poisoning with these or other types of poisons, secure medical aid at once and keep the patient quiet.

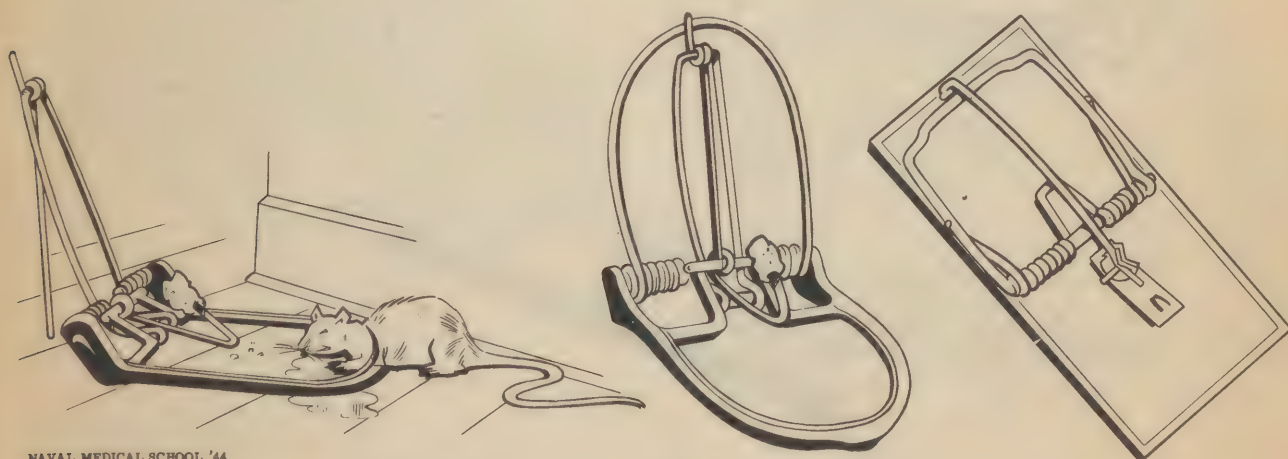
TRAPPING

The habits and the food preferences of the various species of rats must be given careful consideration. Try to find some type of bait or baits that are acceptable to all the rats and then consider the habits of movement and feeding. Place the baited trap where it will intercept the line of travel of the rats and place it in a position such that the rat will take the bait and get caught or will trip the trigger in moving from place to place. The better you know the rats, the more fascinating the work becomes as you attempt to catch that last smart one. Traps that are placed near good rat-cover give best results.

Two or three types of snap traps, one or two types of live traps, and one good type of pitfall trap should be used. Complete coverage of any given area is always desirable. Use plenty of traps in the first trapping campaign following the initial clean-up and in the later attempts at control. When spot-trapping, the use of traps should be restricted to a few well placed sets to pick up the "wise ones."

Bait materials for trapping should be carefully selected, attached securely to the trap trigger, and changed at least every day. The following is a list of materials that may be used to bait traps: Fresh coconut, fresh meat, peanut butter, cheese, salmon, corned beef, oatmeal and peanut butter, and copra (dried coconut). Fresh coconut has been found to be the most satisfactory trap-bait material for the South Pacific area. It is easily attached to the trap trigger and retains its attractiveness for at least a day. Good trapping technic will require a variety of baits to pick up "trap-wise" rats.

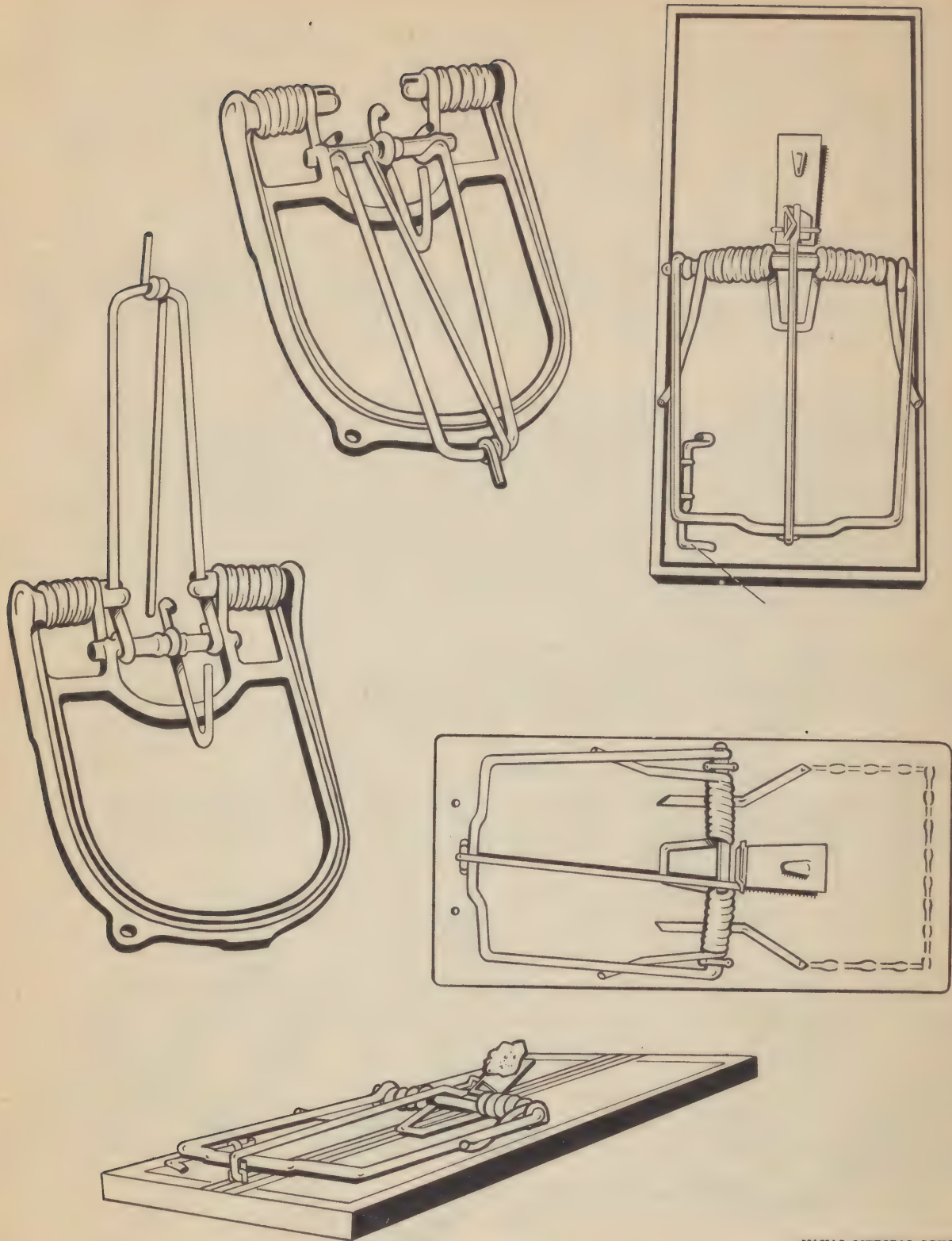
Types of Traps. - The ordinary snap trap with a wooden base is the most readily obtainable for use in wide-spread rat control. Steel base snap traps are more durable and satisfactory when obtainable. A good, all-purpose snap trap is known as the "Schuyler Rat Trap No. 2." This trap is rust-resisting, powerful, simple, sensitive, and fool-proof. It can be quickly and easily attached to level or upright surfaces and at any desired angle if the surface will support a nail or wire. All traps should be taken up and be decontaminated at regular intervals. Any snap type rat trap may be improved by enlarging the trigger pan with an attached piece of thin plywood two by two inches.



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FIG. 3. Mouse Traps.

Trapping



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FIG. 4. Various Types of Snap Rat Traps.

Trapping

Live traps, using the spring-door principle, have proved successful for obtaining specimens and for getting rats for parasite studies, feeding experiments, and other purposes. Their size and bulk limit the use of these traps for control purposes to localities where men and transportation facilities are available. Live traps of the self-catching, non-resetting type are useful in some areas.

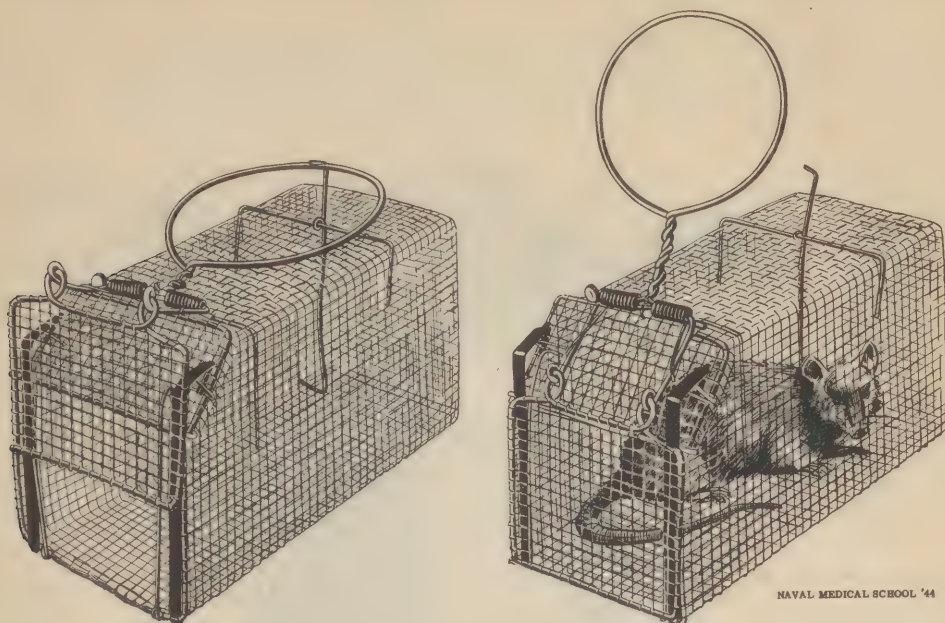


FIG. 5. Conventional Type Live Trap.
This trap was fabricated in the field by the Marines.

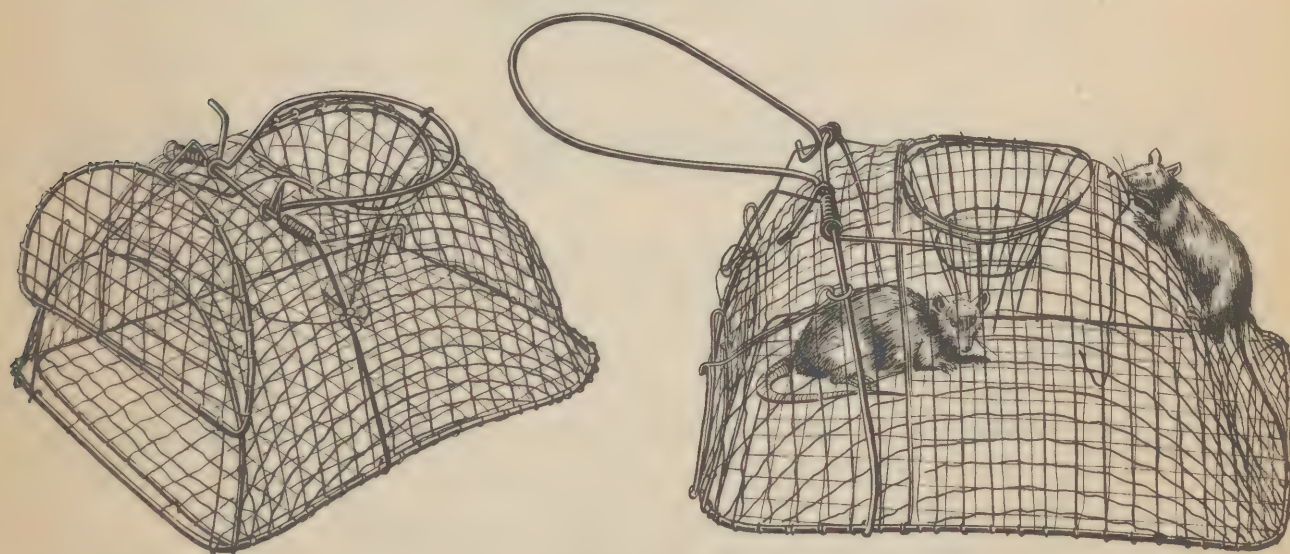


FIG. 6. Self-Catching Live Trap
Designed to catch one rat which will act as a decoy. Other rats enter trap through the hole in the top.

Trapping

Barrel traps can be made from used oil drums or G.I. cans. This type of trap is buried until level with the ground or used alongside piles of materiel or against a bank. The lid is suspended by a rod across the center which acts as a hinge. When reaching for the bait, the rat steps on the lid, tilting it and falling into the barrel.

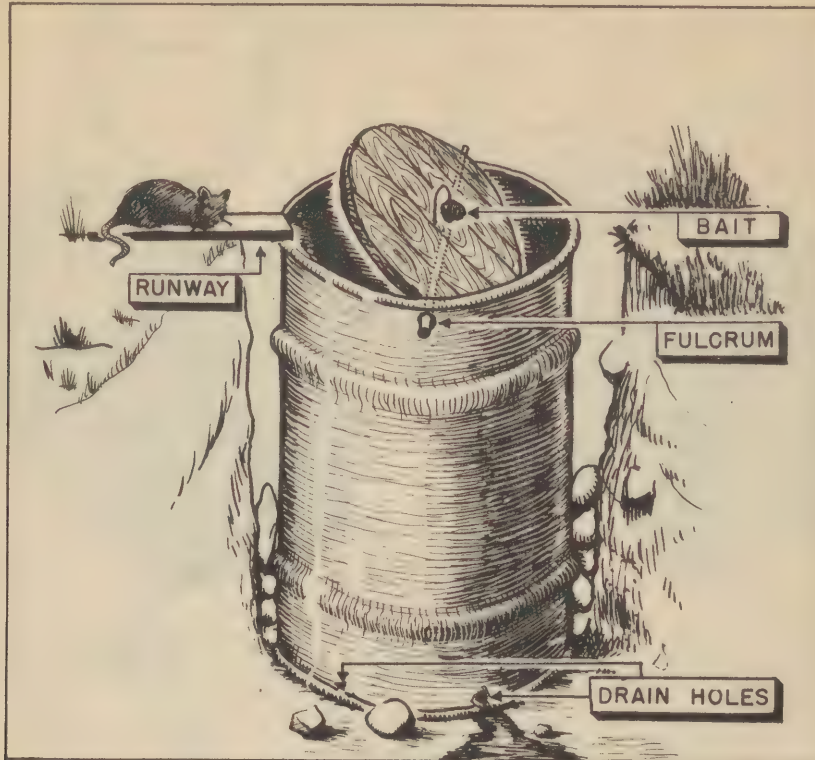


FIG. 7. Barrel Trap

Trap Repairs. - Supplies should be available for use in keeping traps and trapping equipment in good field condition. The following is recommended as best suited for this purpose:

Hardware cloth, galvanized, 1/4 inch mesh (in rolls 36 inches by 100 feet)
Small wire-cutters pliers - side cutters
Power cutters - 10-inch
Pliers, Gorilla Grip - 8-inch

Trap manufacturers. - The following companies manufacture satisfactory rat traps:

Animal Trap Company of America, Lititz, Pennsylvania.
National Live Trap Company, Tomahawk, Wisconsin.
Schuyler, J. R., & Co., Bloomsburg, Pennsylvania.

FUMIGATION

Fumigation of rat burrows is an effective means of rat control and is recommended for use in supply and materiel dumps, vacated foxholes, bomb shelters, and garbage pits where gas can be confined by external walls or temporary cover. Living quarters may be fumigated where it is practicable to vacate them for one or two days and where the building can be gas-proofed to retain the fumigant. Cyanide dust and discs are the most readily available and usable chemical agents for destroying rats by fumigation. When used in sufficient concentration to kill rats, fleas and other parasites are killed at the same time. Cyanide can be used to advantage in treating burrows in fields, along ditch banks and levees, around the exterior of buildings, along docks and wharves, and on garbage dumps.

Portable pumps with flexible hose are supplied for use in applying cyanide dust. The discs come in a specially constructed container with directions for use. All cyanide preparations must be handled with the utmost care. For interior use they should be accompanied by a chloropicrin mixture as a pre- and post-warning agent. Follow directions that are supplied with the containers and applicators. Such material is available from dealers and manufacturers on special request.

Antidote. - For poisoning from breathing cyanide fumes, place the patient in fresh air and slowly administer the fumes of amyl nitrite; hold an ampule of amyl nitrite near the nose for 15 to 30 seconds every three minutes. Secure medical aid.

SHIP-SHORE CONTROL

The control of ship-to-shore and shore-to-ship movements of rats is one of the most important disease control measures. At principal ports of entry and call, the governing port authority requires observation of the following:

Rat Control Regulations for Ships.

1. "Rat guards" will be maintained at all times on all lines connecting ship with docks and will be placed in such a manner as to prevent rats from traveling from line to line.
2. Bow, stern, and spring lines will be illuminated between the hours of sunset and sunrise.
3. All landing ramps and gangways not in use will be removed. All landing ramps and gangways in use will be illuminated and have a guard between the hours of sunset and sunrise.
4. All cargo nets will be lifted aboard ship during hours when cargo is not being transferred at night.
5. Ships having a rat problem may secure the services of an experienced exterminator by contacting the port sanitary officer. Fumigation of ship should not be attempted by an inexperienced crew.

Ship-Shore Control

RAT SHIELDS OR GUARDS:

Rat shields or guards should be constructed of a heavy gauge tin and should be not less than three feet in diameter. They should be made in two sections with collar and clamps or wing nuts to fasten the sections together and to anchor them securely to the line. These shields should be attached to the ship-end rather than the dock-end of the line. The figure below shows the proper type of shield and the method of attaching.

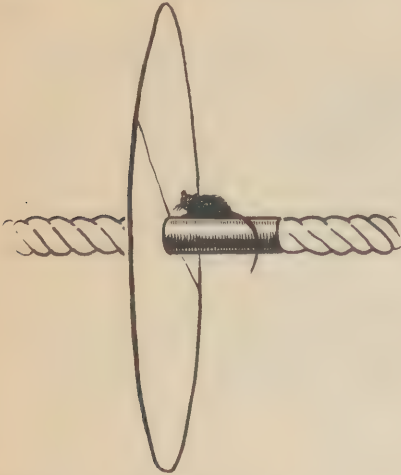


FIG. 8. Rat Shield at Right Angles to Line.

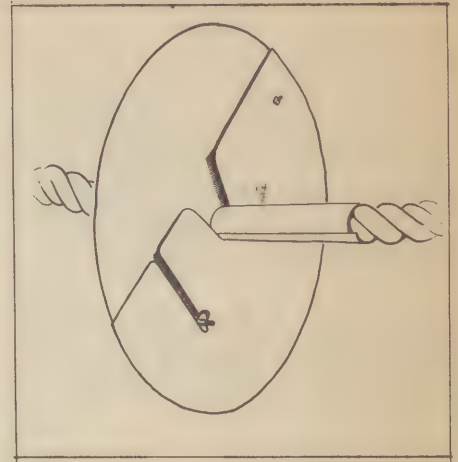


FIG. 9. Shield Showing Wing Nuts and Metal Collar.

RAT CONTROL ABOARD SHIP:

Poisons, traps, and fumigants may be utilized to control rats aboard ships. Since it is imperative that rat carcasses be removed immediately for sanitary reasons, traps and fumigants can be used to best advantage. The conventional type of snap traps will be found satisfactory. One or more men should be assigned to the duty of keeping rat traps properly set and baited. Training and experience are required in trapping ship-wise rats. Careful observation of runways, nesting cover, and feeding habits will indicate where to make trap sets.

Fumigation should be a regular practice in ship sanitation as a means of controlling rats and insect pests. Facilities and personnel are available at principal ports of call. It should be the duty of the Ship's Sanitary Officer to make application to the proper authority for fumigation service.

Rat-proofing of ships should be done whenever time and facilities will permit. Port Authority is generally able to advise regarding the proper agency through which trained personnel can be secured to supervise or perform this type of work. Rigid sanitation practices aboard ship will aid materially in controlling rat infestations.

RAT-PROOFING

Reduced to its simplest terms, rat-proofing any buildings means total exclusion of rats. Concrete foundations with a cut-off wall two feet underground and not less than one foot above ground, metal breaker strips, and the elimination of dead spaces and dark corners serve as a means of excluding rats. The construction of buildings under stress of war conditions has created many rat problems. If the buildings are set on pillars or concrete blocks, then it is important to keep the space beneath the building clear of trash and debris. Such buildings are a perfect rat harbor if any type of cover is provided.

Close any holes through which rats may gain access to buildings: through floors, around floor or ceiling joists, doors or windows, and on the roof. Sheet metal or fine mesh, medium gauge galvanized wire screen, can be used to close or screen openings. Wooden buildings require constant repair to keep the rats out.

Materiel dumps should be arranged so that rats cannot find refuge in them; compact tiers with aisle spaces discourage rats. All brush, trash, and scrap materials in and adjacent to camp areas should be burned or buried. Garbage dumps and disposal pits should be planned so that all combustible material is burned and the remainder is covered with earth to exclude rats and insects. A good incinerator is the best means of garbage disposal in maintaining rat-free premises.

EXPERIMENTAL RAT CAGES

Where time and facilities permit, some of the semi-wild and native rats should be confined in live traps or larger cages for the purpose of checking food habits and the effect of various types of poisons. A good cage for this purpose is about one foot square and two feet long with a trap door on top. Data covering any feeding or poisoning experiments should be recorded and a report forwarded to BuMed.

PREPARING SPECIMENS

Rat specimens should be taken in all localities in sufficient numbers to make a representative collection. A scientific mammal specimen ordinarily consists of two items - the skin and the skull. Live caught or freshly trapped animals should be used for preparing skins and skulls. A specimen, so decomposed in hot weather that the hair slips and the skin is valueless, may be made into a skeleton by cutting off the hide and then removing the entrails. The flesh is then roughly cut away and the skeleton dried in the air; if small, it may be preserved in alcohol - never in formalin.

TOOLS AND SUPPLIES:

Skins of small and even large mammals may be removed with a small pocket knife if no other tool is available. The following equipment is recommended for field use:

- 2 scalpels (large and small)
- 1 pair of scissors (small, pointed)
- 1 pair of forceps or tweezers (slender)
- 1 pair of pliers with wire cutter (small)
- 1 file (three-cornered or flat)
- 1 carborundum (oil stone)
- 1 brush (tooth) to remove dirt, dried blood, and sawdust
- 1 bulb syringe (soft rubber) or piston syringe to remove brain from skull
- Needles and thread
- Paper for labels (durable)
- Pins (glass-headed) to pin down study skins while drying
- Cotton, tow, excelsior, or substitutes, such as dried grass or paper
- Arsenic
- Borax or alum
- 1 Brunton compass
- 1 pair of dividers
- 1 two-meter Tiptop steel tape (Keufel & Esser, No. 7712TM)
- 1 ruler, metric scale, 30 cm. long (Keufel & Esser)

In addition to the above supplies, the preparator's kit should contain the following wire for use in the legs and tails of small mammals:

- No. 15 - For large squirrel, rabbit, or skunk
- No. 17 - For rat or small squirrel
- No. 20 or 23 - For mouse
- No. 16 and 24 - For miscellaneous uses.

Monel wire manufactured by the Alloy Metal Wire Company, Inc., Moore, Pennsylvania, should be specified. No. 20 and No. 24 wire is sold in spools, 185 feet and 125 feet to the pound, respectively.

Preparing Specimens

RECORDING DATA:

Prepare two labels as shown in the sketch, one for the skin and the other for the skull. Use pencil or water-proof ink. On the label to be attached to the skin write:

1. Number assigned to the specimen.
2. Sex.
3. Locality.
4. Date.
5. Name of collector.
6. Total length of animal (tip of nose to end of tail vertebrae with animal preferably stretched on its back).
7. Length of tail (turn tail at right angles with back and measure from base to tip).
8. Length of hind foot (from heel to tip of most distant claw).

On the label to be attached to the skull write the same number and the initials of the collector.

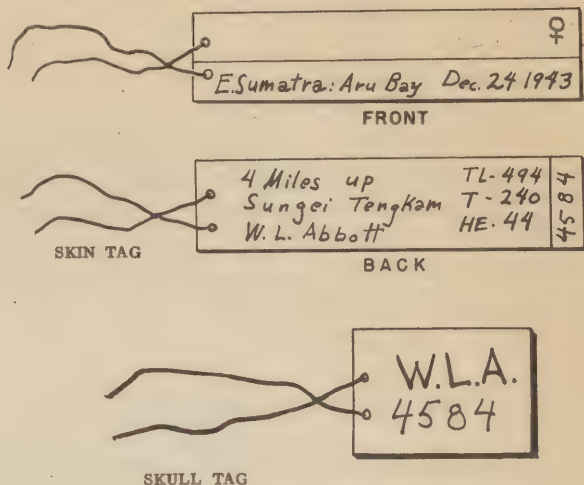


FIG. 10. Labels for Skins and Skulls

SEXING RODENTS:

Extreme care should be exercised in making sex determinations. Sex of breeding animals is easily determined: The testes of the males are descended and extend out from the body at the base of the tail; teats are evident on the females. In non-breeding or young animals, the testes may not be visible. However, the sex can be determined by careful examination. Female rats have three external openings which are fairly close together. The anal opening is at the base of the tail; the vaginal opening is approximately one-eighth inch below the anal opening and immediately next to it is the urethral opening. Males have two openings, the anal and urethral, located in the same region as in the female.

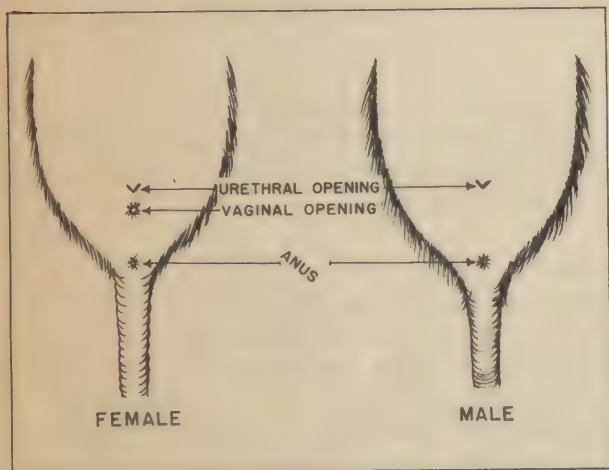


FIG. 11. Sexing Rodents.

Preparing Specimens

AGE DETERMINATION:

Age is even more difficult to determine than sex. Generally, no attempt should be made to classify rats or mice beyond the three classes of juvenile, sub-adult, and adult. Juvenile animals can be distinguished by their small size and by the condition or texture of their hair. The hair of juvenile animals is soft and the long guard hairs are lacking; the color is generally more uniform and slightly darker than in the adult. Sub-adult animals may also be distinguished by the condition of the hair. Guard hairs are present but are not prominent and the hair in general still has a soft appearance. Sub-adults are less uniform in color than the juveniles; frequently a molt pattern will be discernible. Further, although sub-adult animals may be nearly as large as adults, they are usually in a non-breeding condition. Adults can be distinguished from the other two classes by larger size, coarse appearance of the hair, and the condition of the sex organs. Adults are almost always in breeding condition; females are either pregnant or lactating or the vagina will have an open appearance; the testes of adult males are usually descended.

SKINNING A SMALL MAMMAL:

Mammals should be skinned as soon as possible after death. After taking measurements, writing labels, and recording all data, lay the mammal on its back, hold the skin taut along the mid-line of the abdomen, and cut the skin from the end of the breast bone almost to the vent. Beginning on one side, work the skin loose until the hind leg is visible. Push the leg toward the opening from the outside, pulling the knee-joint inward; sever the knee-joint and work the skin downward as far as the heel. Strip the flesh from the section of bone left attached, and repeat the operation on the opposite leg. The free use of fine hardwood sawdust or cornmeal on the exposed flesh will keep the fur clean and prevent hair from sticking to the body while skinning. Use the finger or the flat end of a scalpel to work the skin loose from the body. Cut the skin and the vent free from the body. Then work the skin loose around the base of the tail; holding the skin at the base of the tail firmly with the thumb and fingers of one hand, with the thumb and fingers of the other pull the tail vertebrae out of the tail skin, taking care not to tear the tail skin from the body skin.

Now hold the body by the hind quarters with one hand and work the skin forward with the other, freeing it from the body until the forelimbs are exposed. Manipulate the skin gently and do not pull so that it is stretched. Free the forelegs from the skin in the manner described for the hind legs.

Continue to work the skin forward until it binds at the base of the ears. Carefully cut through the cartilaginous ear bases so as to injure neither the skin nor the skull. The eyes are next encountered. Work the skin forward to the posterior margin and then cut as closely as possible to the skull; with care and practice the membrane holding the skin to the eye sockets will be cut without injury to the eyelids. Cut skin away from the snout until the lips are free. The skin now hangs attached only by the nose. Cut through the cartilage at the end of the nose, taking care not to injure the delicate nasal bones or the skin of the muzzle.

Preparing Specimens

All noticeable fat, adherent flesh, and loose tissue should be removed from the raw side of the skin. It is then dusted with an arsenic mixture. Fat, when present, must be removed by scraping the inside of the skin with a knife or scalpel. Loose scraps of fat and grease may be removed by an absorbent such as cornmeal or fine sawdust. Large skins may be scraped on the surface of a smooth, narrow board more easily than on a flat surface. A hacksaw blade makes a satisfactory scraping tool.

PRESERVATIVES:

The following mixtures are poisons and should be conspicuously labeled: The preservatives recommended as most satisfactory for the skins of small mammals is a mixture, in about equal proportions by volume, of powdered arsenic (dry, white arsenic trioxide) and powdered borax (sodium tetraborate). One pound of arsenic mixed with one pound of powdered borax should be sufficient to preserve 200 to 300 specimens of average size.

Skins of small mammals may also be preserved by a mixture of arsenic and powdered alum, the proportion being about half and half by volume or by weight. This mixture is advocated where the climate is very hot and moist. The preservative mixtures may be kept in the wide-mouthed bottles or tins with friction or screw top covers.

THE SKULL:

Care should be taken not to damage the back of the skull when it is severed from the neck. Under ordinary conditions do not attempt to remove the eyes, tongue, or large muscles from the skull of any mammal smaller than a rat. Remove the brain by squirting water from a soft-rubber bulb syringe or a piston syringe into the opening for the spinal cord at the base of the skull; or carefully scoop out the brain with a wire flattened and bent slightly at the end. One end of the thread attached to the skull label can be forced through the flesh at the fork of the lower jaws and out the side of the mouth and the two ends securely tied. The skulls can be cared for as they accumulate by "stringing" them on a cord or wire passed through the loops of thread attaching the labels. Hang them out of reach of prowling animals, such as cats, and dry by artificial heat or direct sunlight where necessary. Never place salt, alum, or formalin on a skull. If infested with maggots or otherwise obnoxious because of a disagreeable odor of decay, dip the skulls in boiling water.

FILLING STUDY SKINS:

A properly prepared study skin should have essentially the same measurements as those taken before skinning the animal. Select a piece of cotton which will approximate the original size of the animal's body after it is rolled; with the forceps, grasp the rolled cotton at the end which is to go into the head; insert it through the opening originally cut in the abdominal region. With the other hand slip the skin over the roll of cotton until the end held by the forceps reaches the nose. Remove the forceps and work the skin backward over the rolled cotton.

Preparing Specimens

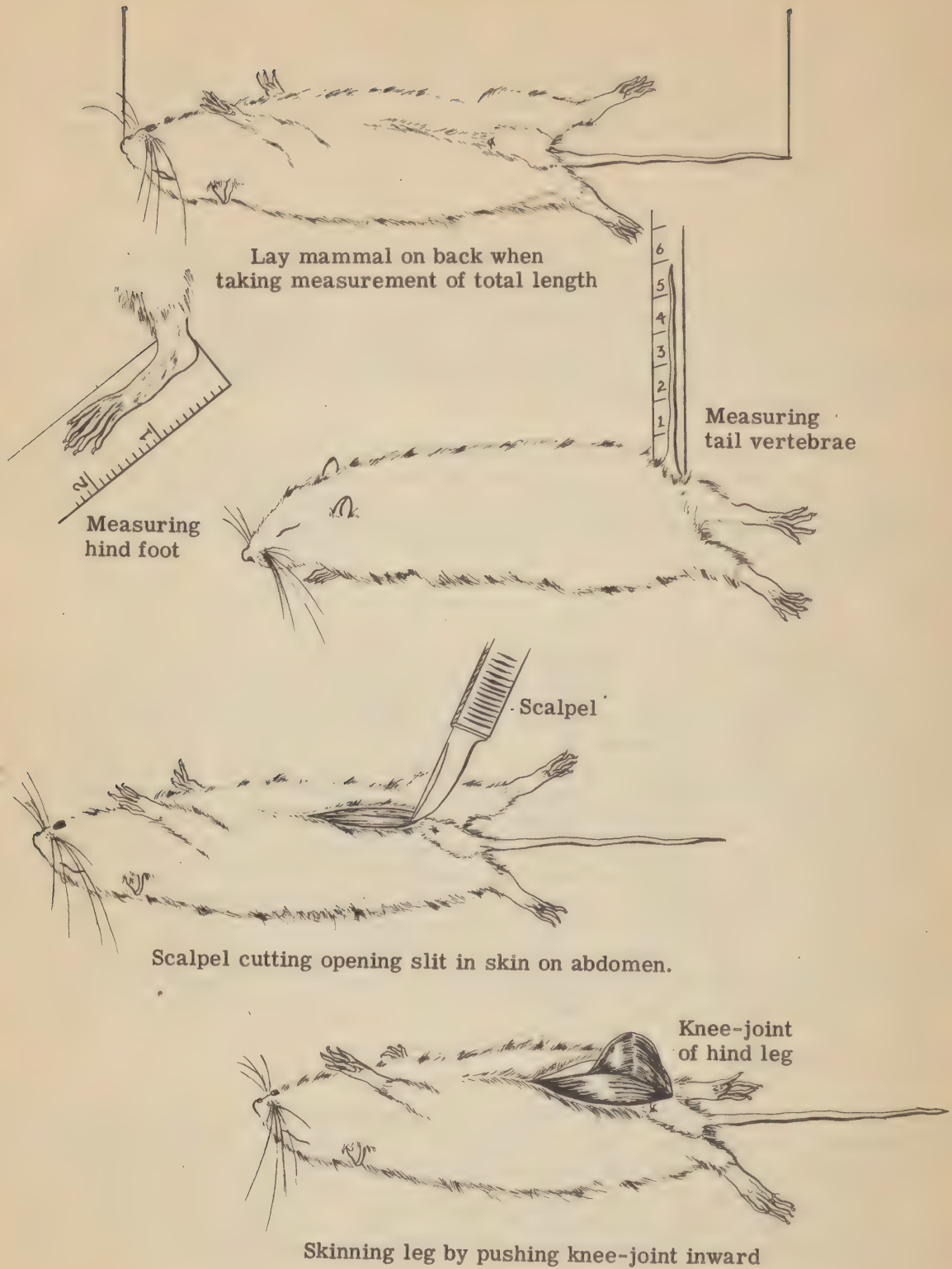
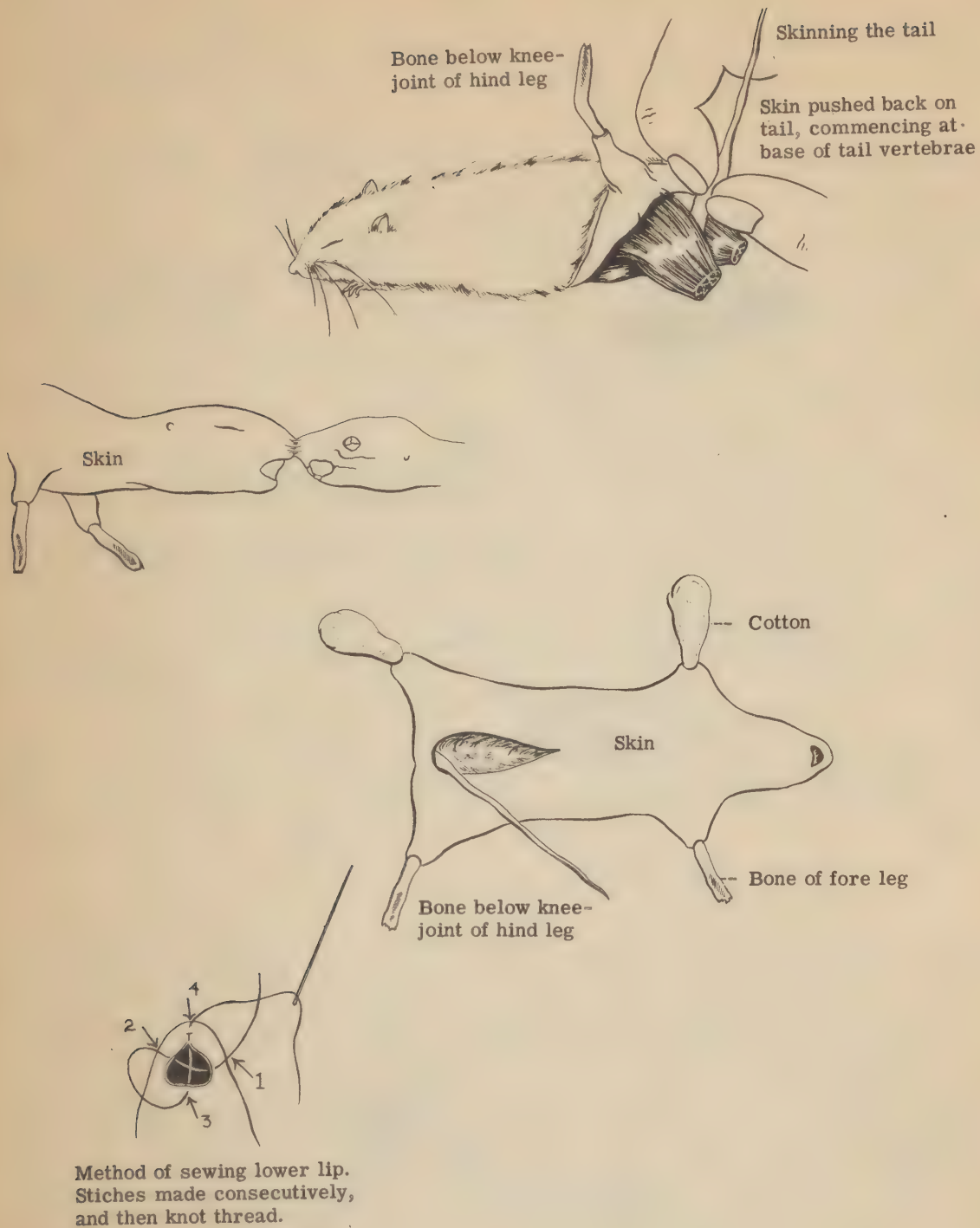


FIG. 12. Measuring and Skinning Specimens

Preparing Specimens



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FIG. 13. Skinning and Stuffing

Preparing Specimens

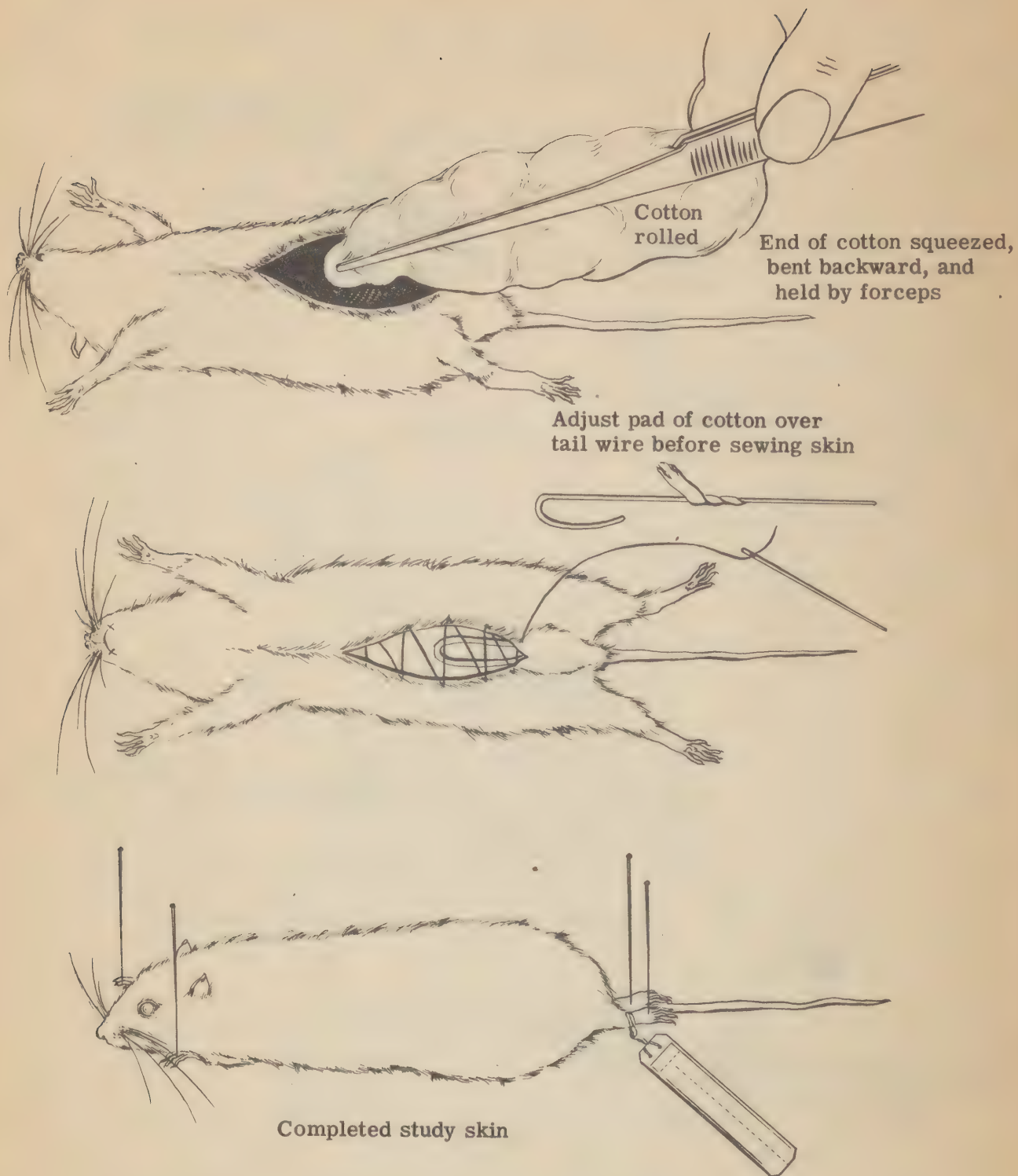


FIG. 14. Stuffing the Study Skin.

Preparing Specimens

Wires, if available, should now be inserted in the legs and tail. Insert the wire alongside the leg-bone into the foot, taking care not to distort the heel; then twirl or wrap a small piece of cotton around the inserted wire and leg-bone to fill out the skin of the leg. If wire is not available, wrap a piece of cotton around the leg-bones.

Considerable practice is required to wrap cotton satisfactorily around the tail wire. Splinters of tough wood or bamboo may be substituted when wire for the tail is not available. A long thin shred of cotton is selected and this is twisted or wound around the wire or splinter, tightly at the end that is to go to the tip of the tail, more loosely toward the base, so as to resemble a tapering form similar to the tail bones. The cotton must be wound smoothly, without lumps or loose strands; before insertion, it is dusted with arsenic. After inserting the tail wire, the free end is bent into a loop and laid in the center of the artificial body to give support to the tail when the skin is sewed up. Uneven places in the stuffed skin should be filled in with pieces of cotton before closing the skin.

Tie the skin label securely to the right hind foot just above the heel. The skin is now pinned down on a board, preferably of soft wood. Pin the hind feet with soles down as close as possible to the tail; the fore and hind feet should not project beyond the sides of the body. The body is given a final shaping while the stuffed skin is pinned down. Never dry a skin in direct sunlight or by artificial heat, except in very damp climates. If exposed to sunlight for drying, the skin should be covered with paper. (CAUTION: Carcasses should be sprayed with a disinfecting solution, such as carbon tetrachloride, before skinning or rubber gloves may be used.)

NOTE: All packages should be labeled "Skins and Skulls of Mammals" and addressed to U. S. Naval Medical School, Bethesda, Maryland, Attention Dr. Remington Kellogg, Curator, Division of Mammals, U. S. National Museum.

PRESERVATION OF PARASITES

To provide a complete picture of the public health aspects and to obtain other scientific data, it is suggested that efforts be made to collect all types of ectoparasites. The live rat should be placed in a strong paper sack and dispatched by a blow on the head; or a dose of ether or chloroform may be administered to kill the rat and to numb or kill the parasites. Slit the paper sack and quickly, but carefully, examine the rat for ticks, fleas, lice, and mites. (CAUTION: Use rubber gloves for this operation.) The ears, thighs, and the area between the front legs and along the belly are the most likely places. Mites and chiggers have a tendency to attach themselves to the ears and around the nostrils of the rat. Extreme care should be used in removing mites and chiggers, making sure that the mouth parts are kept intact. It may be necessary to cut away a portion of the rat's skin; when placed in alcohol, mouth parts will relax and the mites and chiggers can be separated from the tissue.

Many parasites can be picked up in burrows and nests of rats. Nests and litter may be placed on a coarse mesh screen suspended by a shallow pan partly filled with water. A glass jar or other suitable cover is used to retain the parasites

and permit air circulation. As the parasites hatch out, they will fall into the water from which they can be strained by a fine mesh cloth. A hand lens is indispensable in locating and handling parasites. Many body parasites quickly leave the host at the time of death; it is necessary to keep a sharp lookout for any that may hop or crawl away. The parasites are placed in small vials or bottles containing 70 per cent alcohol. Labels should be securely attached, giving data as to where, when, and by whom collected, species and sex of the rat from which removed, and any other pertinent information. These containers should be securely corked, carefully packed, and shipped to the Naval Medical School, Bethesda, Maryland.

The following publications on taxidermy are recommended:

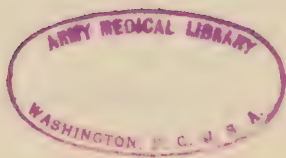
Farnham, A.B.: Home Taxidermy for Pleasure and Profit. A. R. Harding Publishing Co., Columbus, Ohio, 1916.

Hornaday, W.T.: Taxidermy and Zoological Collecting. Scribner, New York, 1891.

Pray, L. L.: Taxidermy. The Macmillan Co., New York, 1943.

Rowley, J.: Art of Taxidermy, D. Appleton & Co., New York, 1898.

School of Taxidermy: How to Learn Taxidermy, School of Taxidermy, 3288 Elmwood Building, Omaha, Nebraska.



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